

# **Natural Gas Vehicle Technology Forum**

**Technical Committee Meeting**

**Sept. 9-10, 2003**

**Albany, NY**



**FuelMaker**



# Status Review

## Home Refueling Appliance

## Mini Fast Fill



# Phill



# VRA \ HRA EVOLUTION

## VRA

- \$US6000
- 1 GGE/hr
- 4000 hr service
- External dryer
- Commercial use
- Outdoor installation
- 45 dbA
- 240 Volt



\$US 6.0 m



3 yrs.

## HRA - U.S./Cdn. Model

- \$US999
- H2 & Nat. Gas
- .42 GGE/hr (1.46 m3/hr)
- Maintenance - free
- Integrated Dryer
- Residential design
- Indoor installation
- 38 dbA
- 120 Volt, 60 Hz.
- Integrated ventilation and gas detection



## HRA - European Model

*(Gaz de France Partnership)*

- 50/60 Hz.
- 240/120 Volt

\$US 1.0 m  
16 months



# **HRA Development - Funding**

***(\$6,000,000 project)***

## **Supported by:**

- **DOE (U.S. Department Of Energy)**
- **SCAQMD (South Coast Air Quality Management District)**
- **Canadian Federal Government**
- **CARB (California Air Resources Board)**
- **CEC (California Energy Commission)**
- **GRI (Gas Research Institute)**
- **Honda**

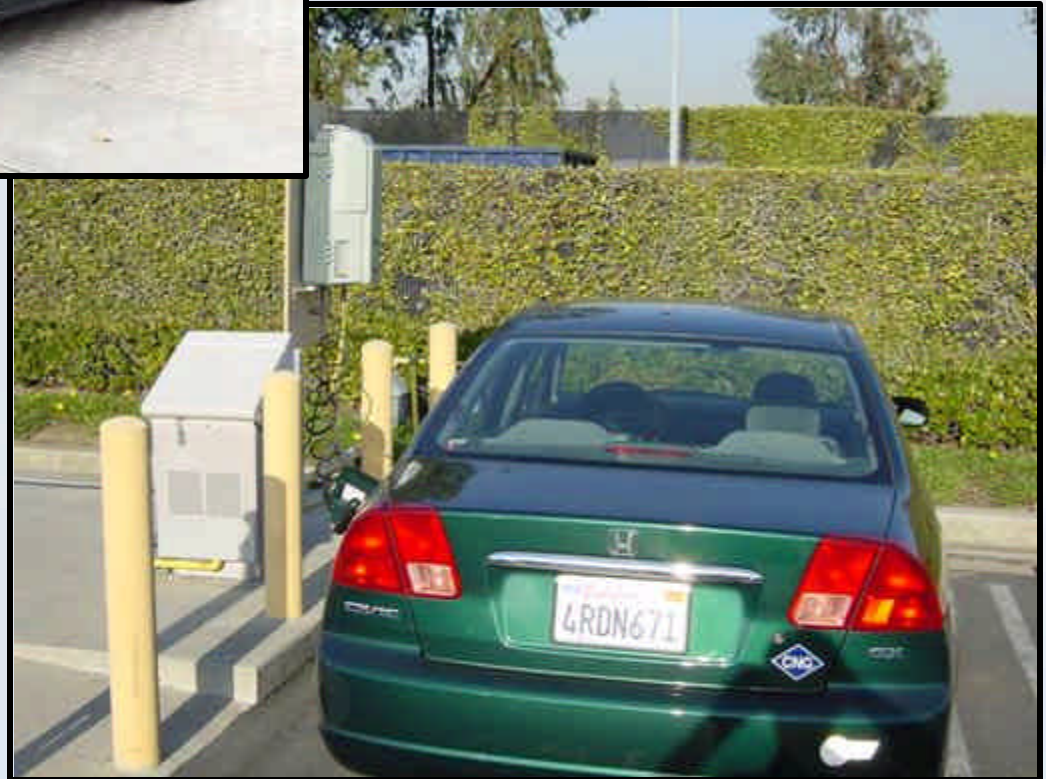




## Phill Testing at Honda in California

### Phill Program

- 15 Alpha Prototypes running
- 120 Beta pre-production units
- field testing starting Sept. '03
- U.S. commercial launch – 2004



# The Phill/Civic GX Concept

- **Honda Civic GX**
  - Range of 220 miles
  - Cost Premium of \$4,400 (expect to reduce in future)
  - Dedicated NGV - 1/10th ULEV
  - Will encourage entrance of other OEMs
- **FuelMaker Home Refueler**
  - \$ 999
  - Indoor & Outdoor Use
  - Maintenance-Free
- **Benefits**
  - Place ultra-clean vehicle technology within reach of 160,000 commuters/year
  - Indigenous fuel
  - 32% reduction in greenhouse gas emissions, 38% CO<sub>2</sub>
  - 90% reduction in ground level emissions
  - Vehicle range & performance equal to today's gasoline vehicle
  - Home - based refueling



# Phil / HONDA CIVIC GX

Refueling Capacity:

	Typical	High
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Annual Miles	10,000	15,000
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Daily Miles (325 days of driving per year)	30	46
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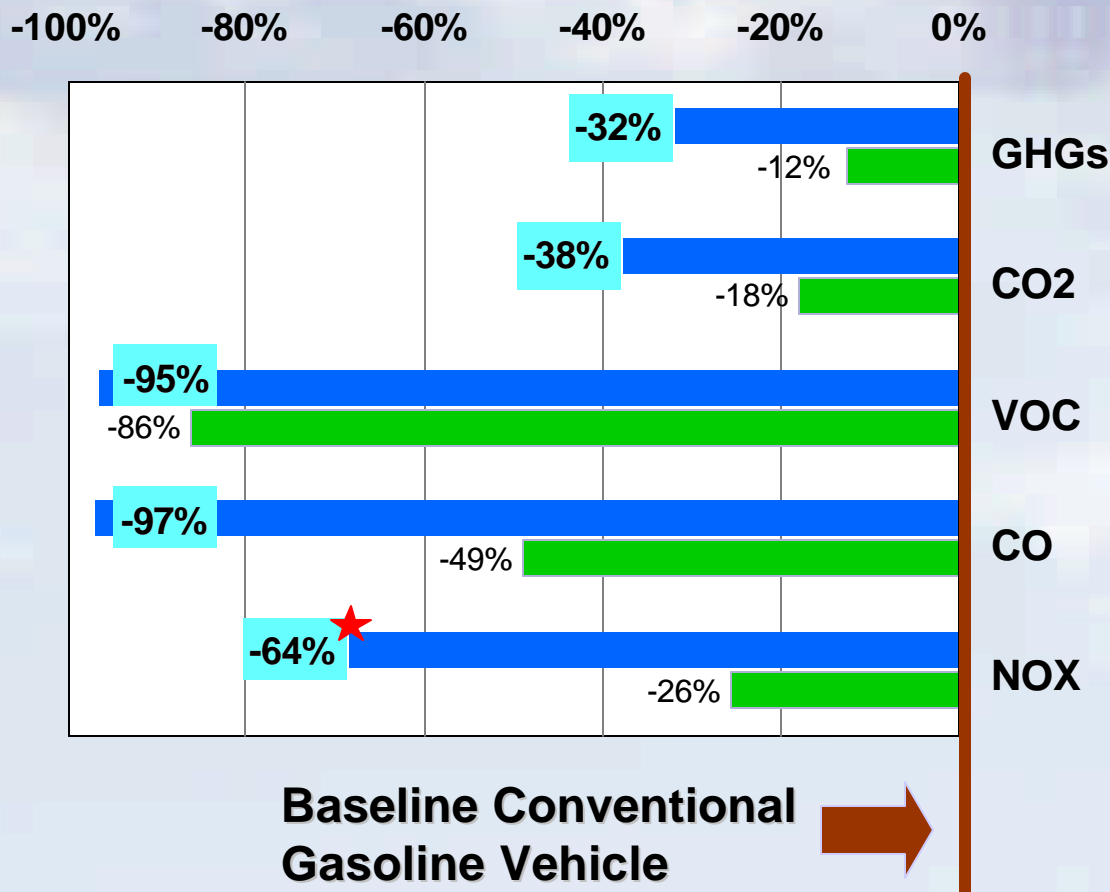
Daily Fuel Consumption (in GGEs, @ 30 mpg)	1.0	1.5
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Overnight Refueling Time (in hours)	~3	4~5
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# CIVIC GX / FUELMAKER FULL FUEL CYCLE BENEFITS (‘wellhead to wheels’)

GHG and Emission Benefit Relative to Conventional Gasoline Fleet, %



**Honda Civic GX/HRA**

**Typical CNG**  
(GREET Baseline)

- ★ Greater NO<sub>x</sub> reductions available depending on local infrastructure (compressor).
- DOE GREET 1.4 model used to calculate emission reductions.
- Civic GX estimates based on EPA combined F.E. discounted 15%, and emissions at 1/10 ULEV (on and off cycle).
- CNG and gasoline baselines are GREET near term fleet assumptions, with F.E. values also discounted 15%.



# Phill Features

- **Extremely quiet - low vibration**
- **Maintenance-free (5000 hours)**
- **Certified as a Vehicle Refueling Appliance for indoor & outdoor use**
- **Easy to use**
- **Gas quality tolerant**
- **Hourmeter - internal**

# Phill Features

- **Easy installation, either indoor or outdoors:**
  - **120/240 volt, 50/60Hz electrical supply, 15ft power cord**
  - **gas connection similar to gas fireplace or water heater**
- **Fully regenerative, maintenance-free gas dryer, reducing 40lbs/MMSCF of inlet gas moisture to 0.5lbs.**
- **Temperature/pressure compensated for ambient temperatures of -40°F to +115°F**

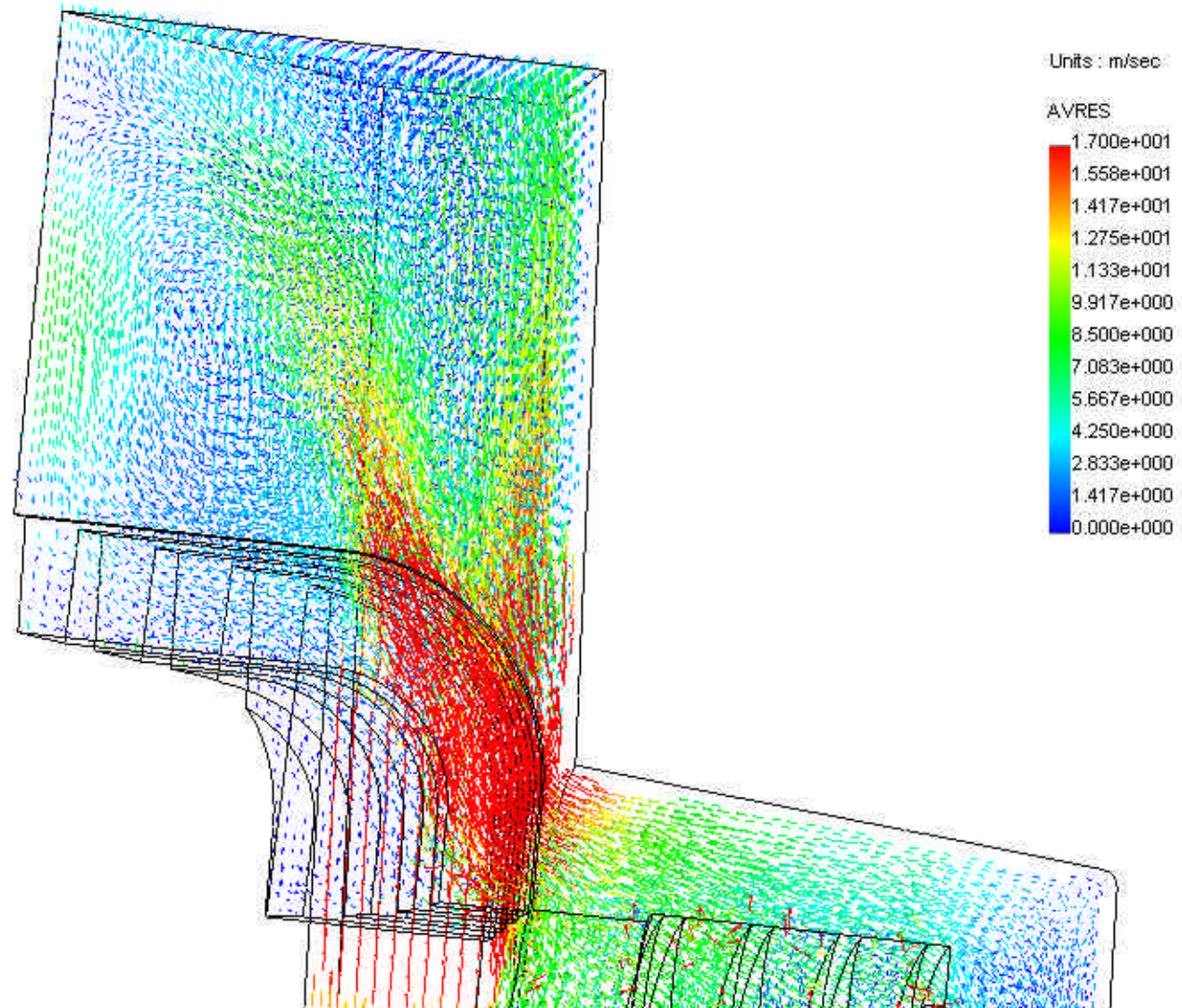


# **Phill Unique Safety Features**

- **Integrated indoor ventilation by direct exhaust through the wall - airflow permissive**
- **Integrated gas detection within HRA air flow path - audible indication and shutdown**
- **In-line break-away**
- **Withstand 10 V/m EMI (Electromagnetic Interference)**

# Phill Technical Advances

## Optimised Cooling



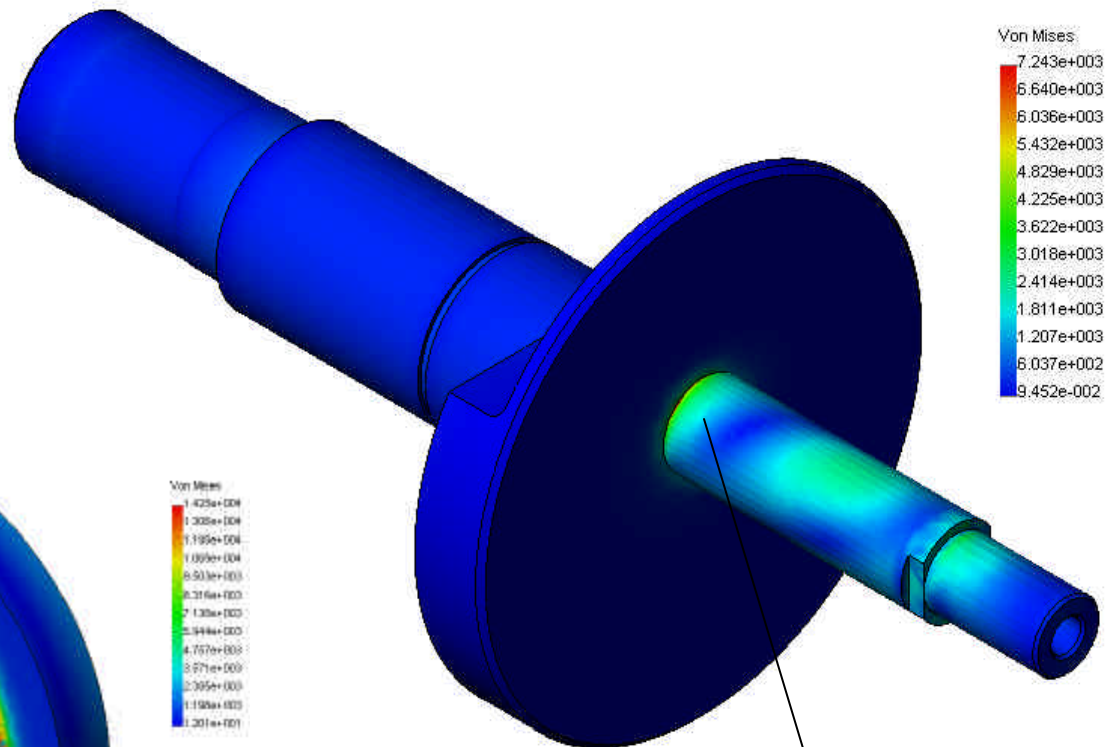


# Phill Technical Advances

## 3D Modeling and FEA

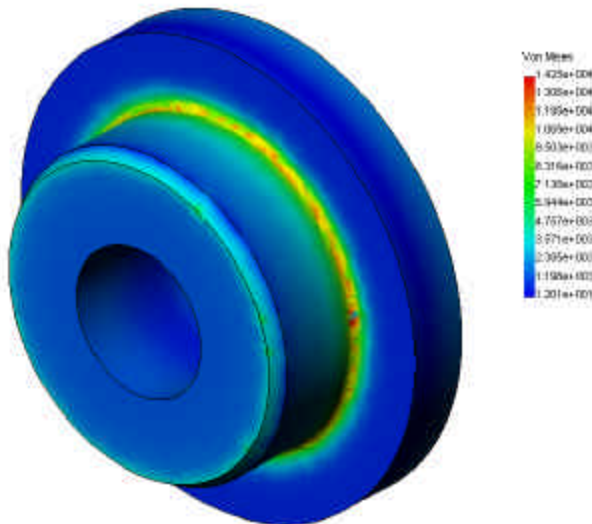
3-0646-Crankshaft study :: Static Nodal Stress

Units : psi



4-1045-Study :: Static Nodal Stress

Units : psi



**Figure 10**  
**Maximum stress area**



# Phill Status

## Safety Study and analysis:

- FMEA done to identify and correct potential weak points
- DOE/NREL/Tiax Safety Study, Phase 2, underway including in-garage flow simulations
- Safety Study underway with Gaz de France
- ongoing reliability and durability testing

# Phill Status

## Electronics

- power factor correction and Ground Fault Interrupter compliance were major issues
- flow rate increased – caused switch from 3/4 Hp to 1 Hp motor

## Certification

- file opened with CSA
- “field certification” received
- submit unit for full certification during last quarter 2003



# Phill Launch Program

## Pre-production program

- Program extended to allow longer durability testing period
- First units to be installed at test sites in September

## Full Production Launch

- Launch of Phill in 2004
- Rollout to commence in California with current Civic GX

## Government incentives

- Have applied to Clean Cities for price incentive for the first 500 units in California
- Other government incentives pending (i.e. Clear Act)



# **Phill Launch - International**

## **European HRA (240 Volt, 50 Hz.) Program**

- Memorandum of Understanding with Gaz de France
- Cooperation Agreement finalized

## **Other HRA Programs**

- discussions ongoing with Osaka Gas



# Media Coverage

(as a result of Honda's press release)

**OTTAWA CITIZEN**

NEWS STORY

## Phill the filler lets you gas 'er up at home

Vito Pilleci  
The Ottawa Citizen; with files from CanWest News Service

Friday, August 29, 2003

Honda is to become the first automaker to mass-market a natural gas powered car -- with a little help from Phill the fuel filler.

Phill, who sits on your garage wall and allows you to plug into your domestic natural gas supply for a fill-up, is the brainchild of Toronto's FuelMaker Corp.

### Story was also covered by:

Associated Press  
Boston Globe  
Detroit Free Press  
Columbus Dispatch  
Alternative Fuels Today  
680 News Radio  
1010 CFRB  
104.5 CHUM FM

Global TV - "Moneywise"  
(to be aired September 15/03)

**Los Angeles Times**  
**latimes.com**

August 29, 2003

## Honda to Mass Market Natural Gas Civic

■ The GX, which is set to go on sale in the second half of '04, will cost \$3,000 more than the gasoline-powered one.

**USA TODAY** | **Marketplace**

## Cars

Posted 8/27/2003 10:05 AM Updated 8/27/2003 10:05 AM

## Pump lets natural gas Civics go to market

By David Kiley, USA TODAY

DETROIT — Honda next year will begin mass-marketing natural-gas-powered Civics that will come with a device to fill the car's tank in the owner's garage.

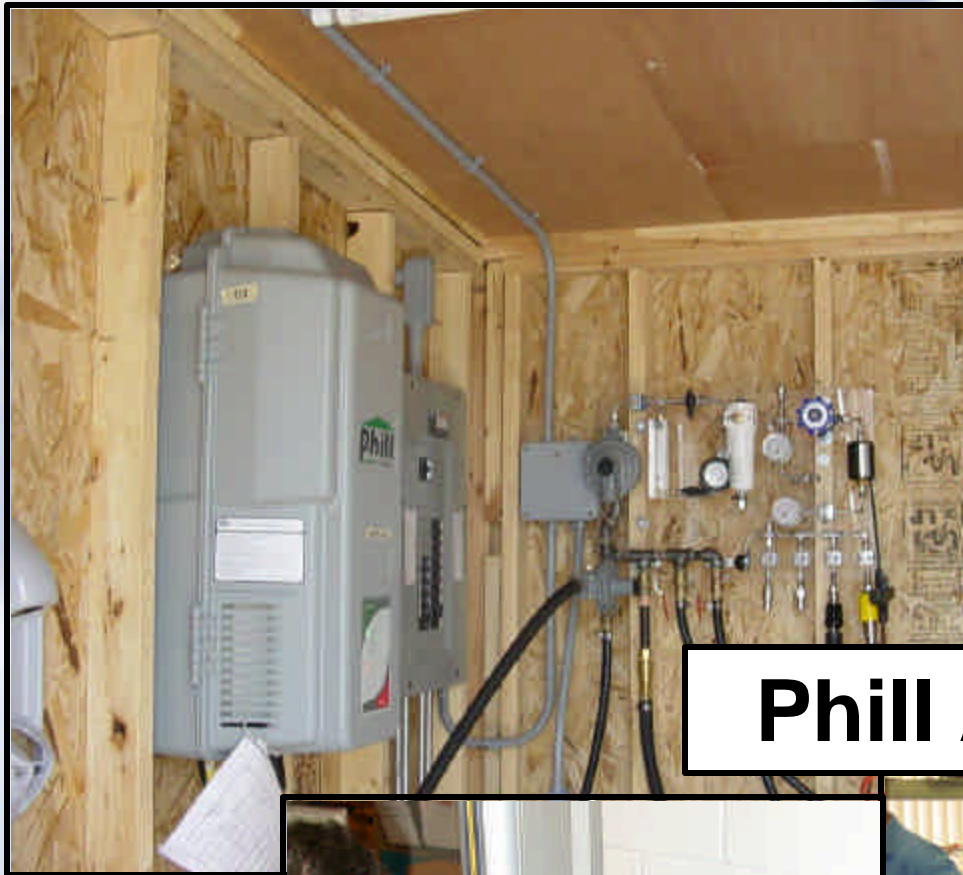


Honda's Civic GX runs clean on natural gas, and owners can fill up at home.

It's the first time an automaker will sell a natural-gas vehicle broadly to the public. Up to now, sales have been mostly limited to specialized fleets such as airport vans and university campus vehicles.

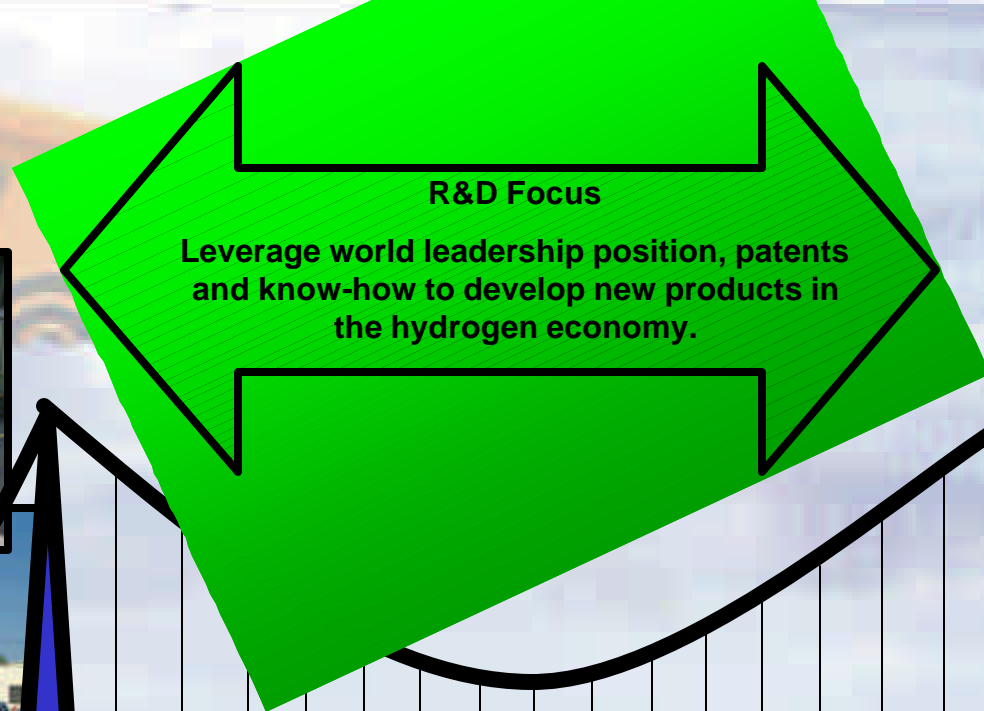
Honda has sold 500 to 1,000 natural-gas Civic GX models a year since 1996 to customers such as the New York Department of Transportation, which owns 400. They are popular for commercial fleets that travel short distances and have their own designated filling stations.

"What's kept natural-gas vehicles from driveways is an easy, reliable way to refill, and we've got that now," says Stephen Ellis, head of Honda alternative vehicle sales.



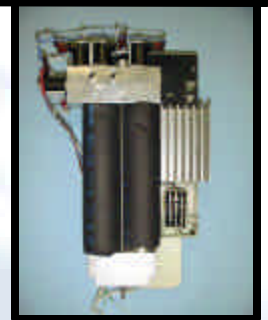
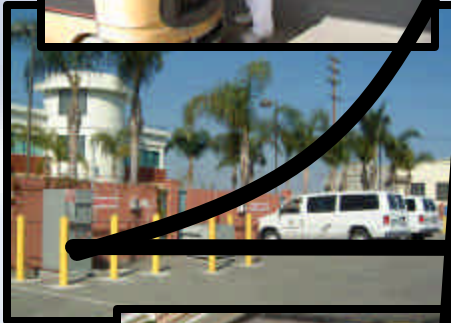
# Phill Assembly & Testing





**R&D Focus**

**Leverage world leadership position, patents and know-how to develop new products in the hydrogen economy.**



# **THE BRIDGE TO THE HYDROGEN FUTURE**



# Phill's Role in the Energy Infrastructure Evolution

**Present**

Natural Gas

Biogas



**CNG Vehicle**



**Heat (Home)**

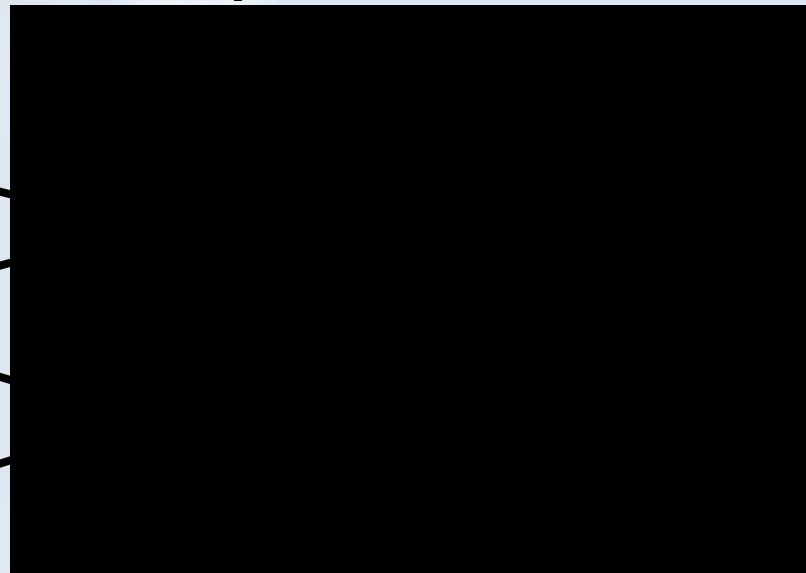
**Future**

Natural Gas

Biogas

Water

Electricity



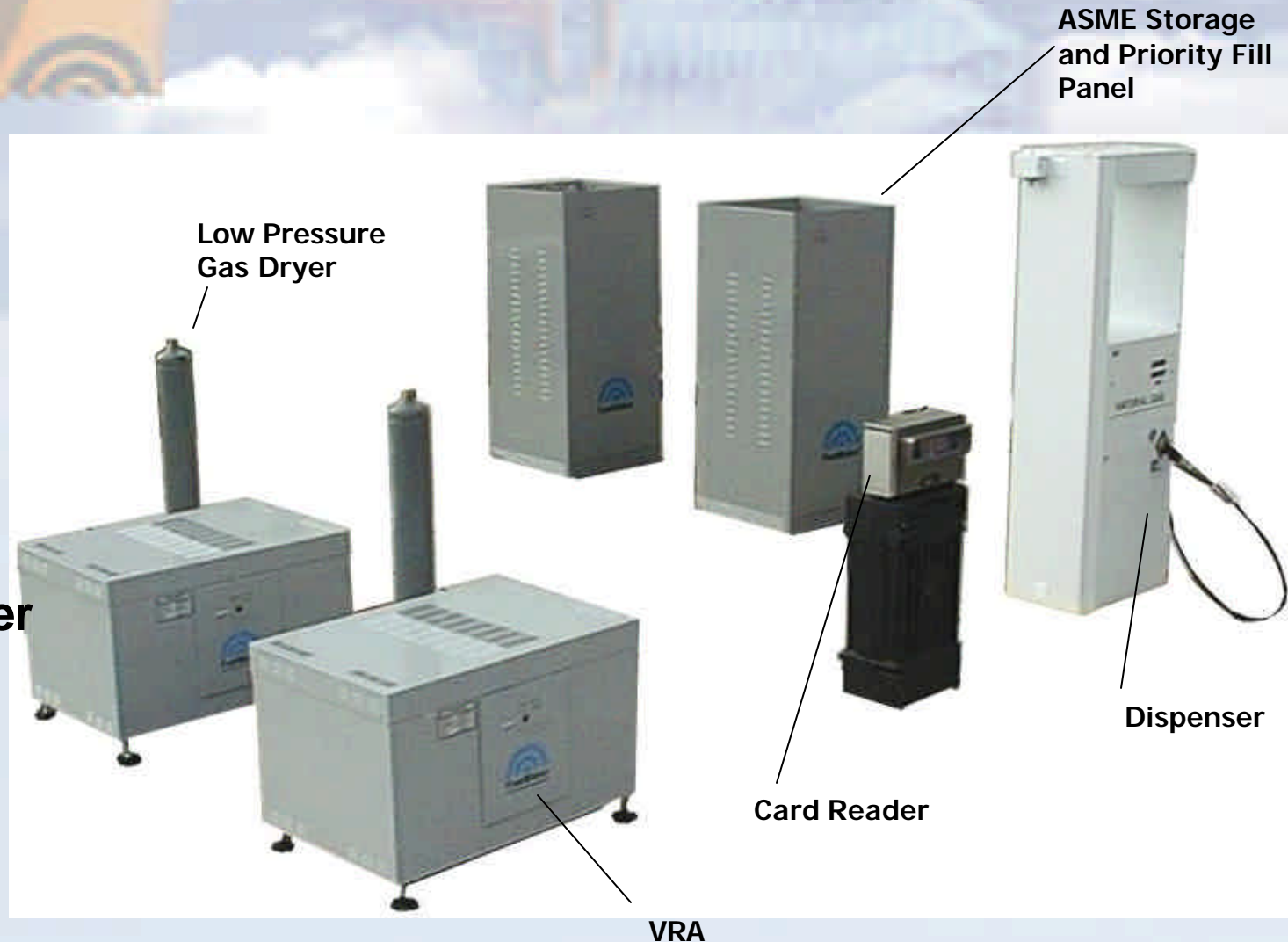
**Electricity  
(Home & Grid)**

**H<sup>2</sup> Fuel Cell Vehicle**



# Mini Fast-Fill CNG Station

- VRAs
- Dryers
- Storage Systems
- Priority Panel
- Dispenser
- Card Reader





# VRAs

- **Redundant Oil-Free Compression**
- **P42/P36 (P50) Temperature Compensation**
- **Pressure Start Activated**
- **Extensive Diagnostics**
- **Optional Remote Monitoring**
- **Modular Service**
- **Appliance Certified**



Model FMQ-7-42 (P42)

Model FMQ-8-36 (P36)

# Dryers



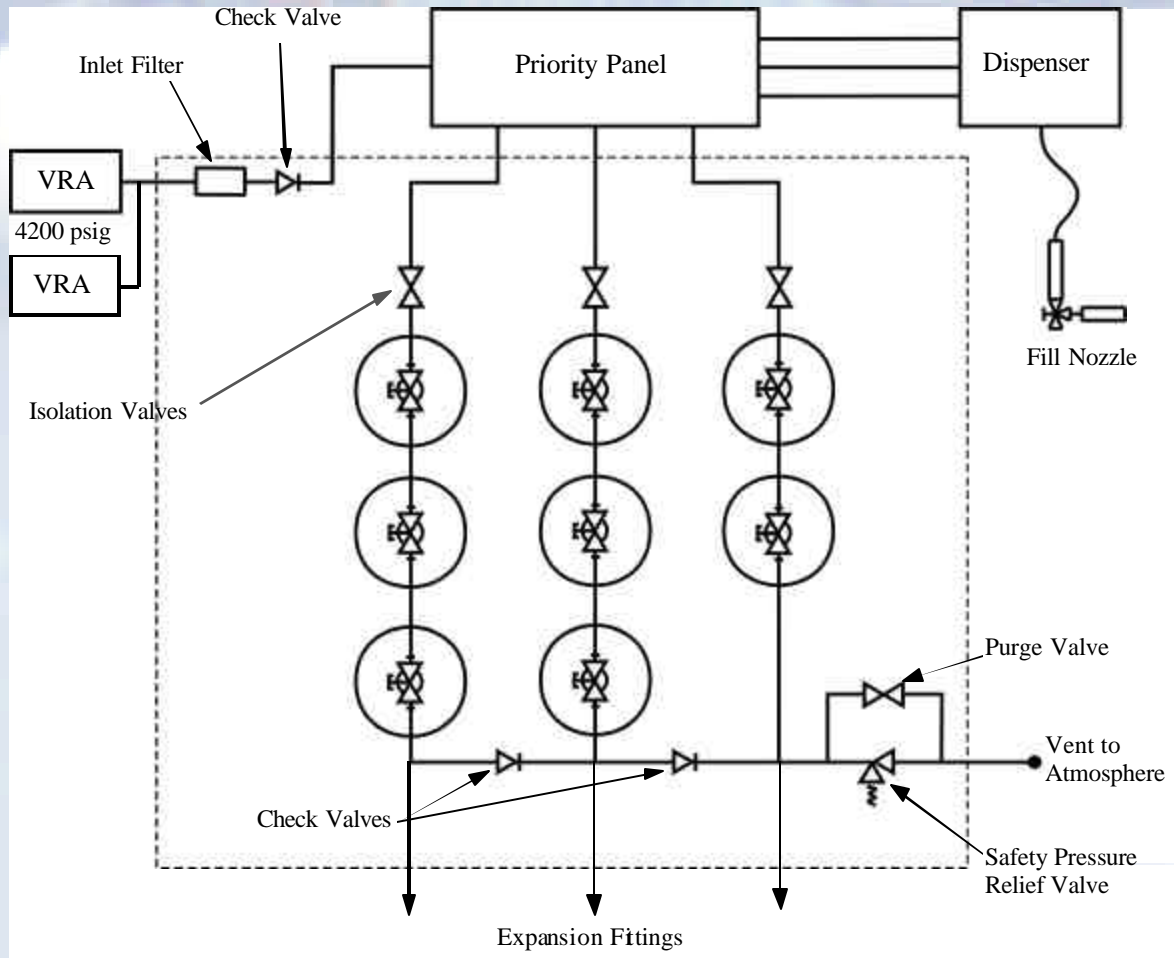
- **Enamel Paint Finish**
- **Compact Upright Vessel Mounting**
- **30 lbs Molecular Sieve Desiccant**
- **1" NPT Inlet/Outlet Connection**
- **Optional AutoDew Monitoring**

**Low Pressure Tower Dryer**

# Three Bank Storage System



Three Bank Storage plus  
Supplemental Storage System

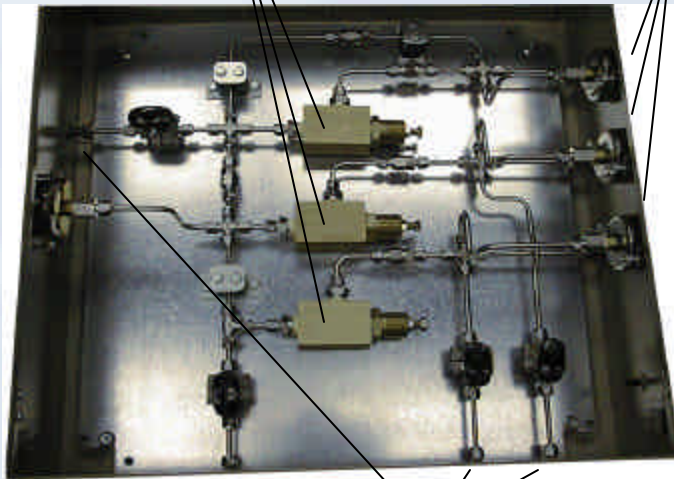


# Priority Panel

- **Adjustable Priority Valve Settings**
- **Heavy Gauge Powder Coated Housing**
- **Integrated in Three Bank Storage System**
- **Storage and Delivery Pressure Gauges**

Priority Valves

Storage Outlet Fittings

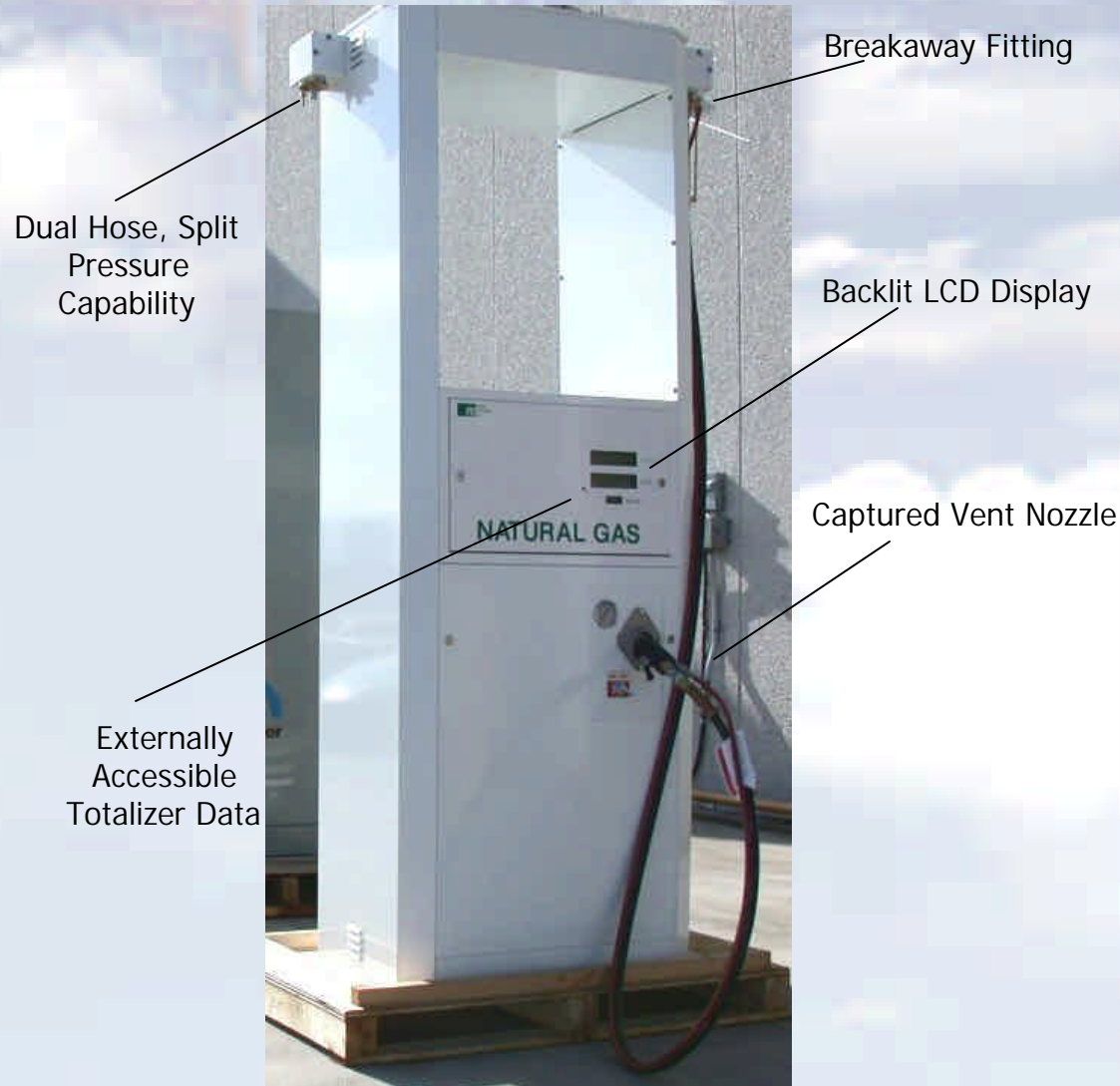


Compressor Inlet Fitting

Dispenser Outlet Fittings

# Dispenser

- **P30 / P36 Delivery Pressure**
- **400 scfm Flowrate**
- **One or Two Hose Configuration**
- **Split Pressure Option**
- **Full Function Island Dispenser**



# Card Reader

2 x 20 Backlit LCD Display

Magnetic Stripe Reader

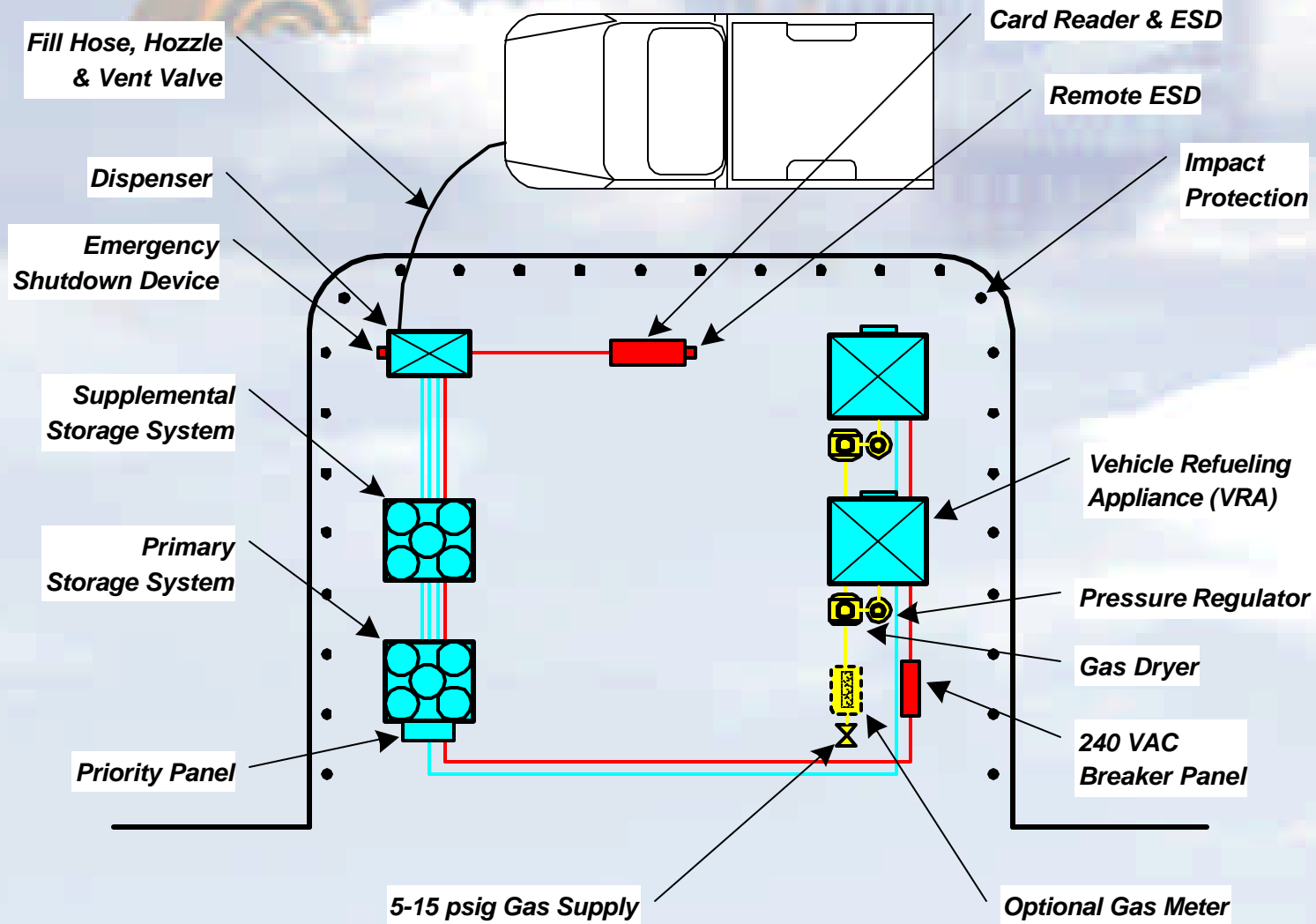


Pedestal

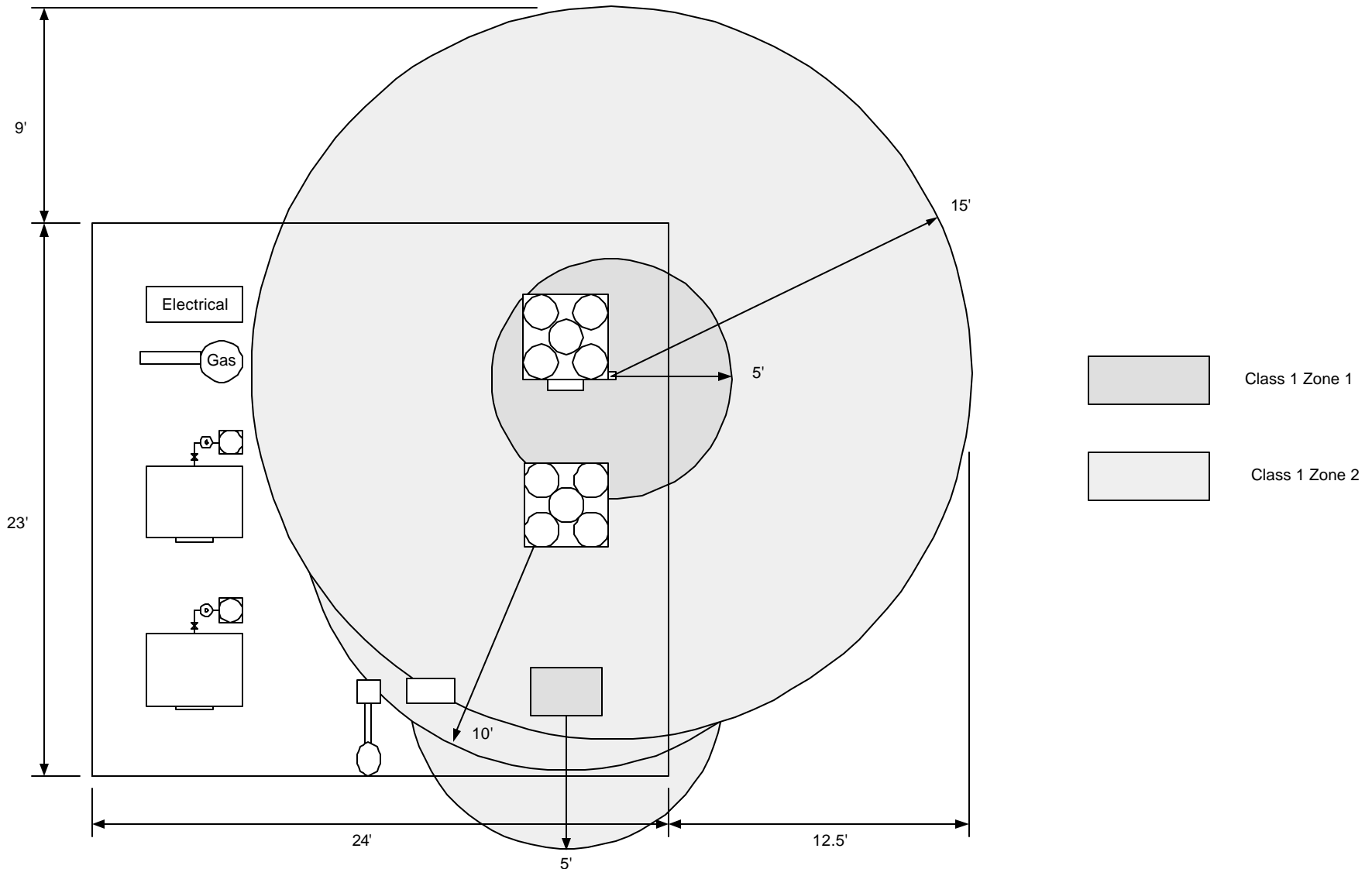
Base



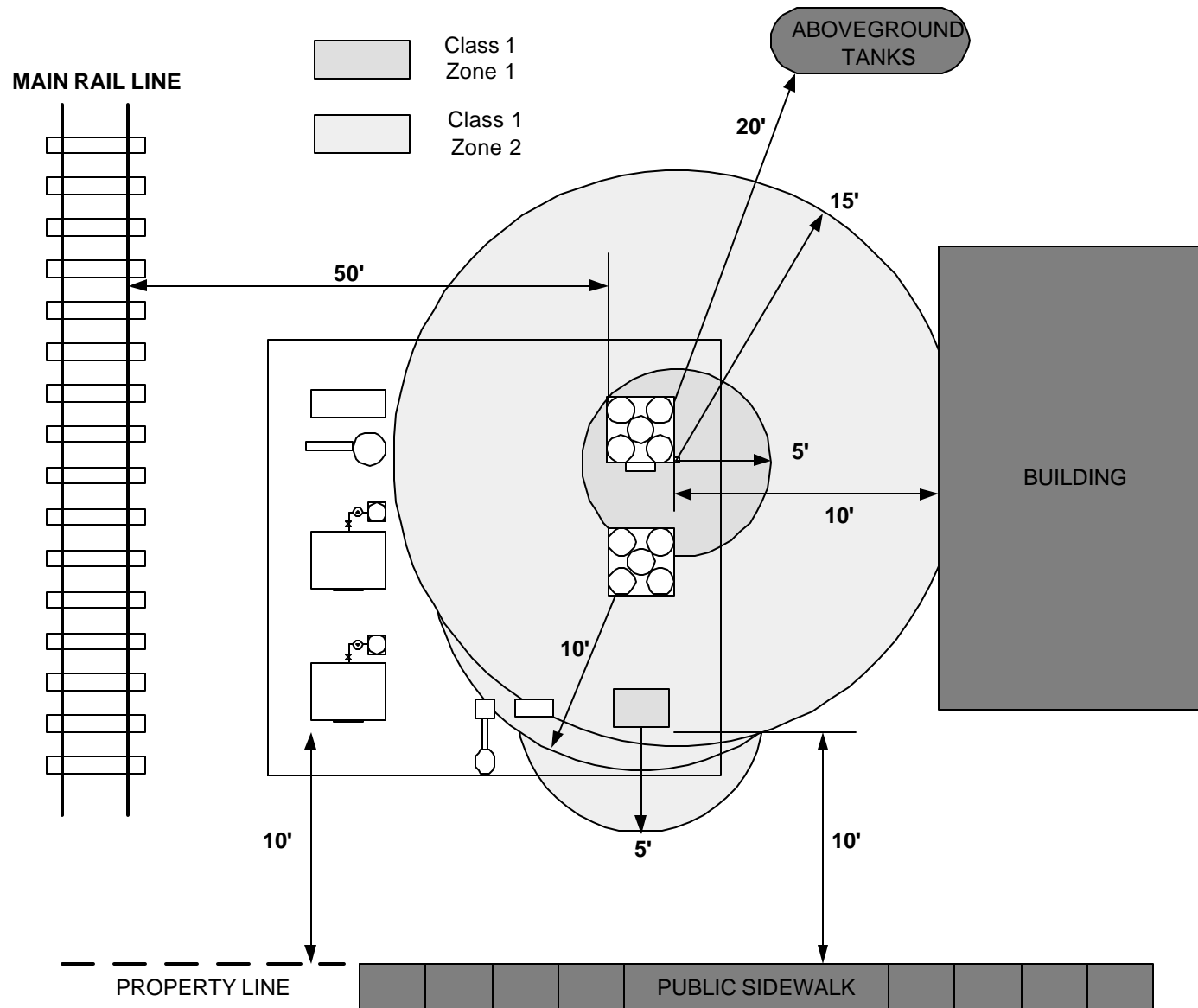
# Equipment Layout



# Electrical Classifications



# Clearances











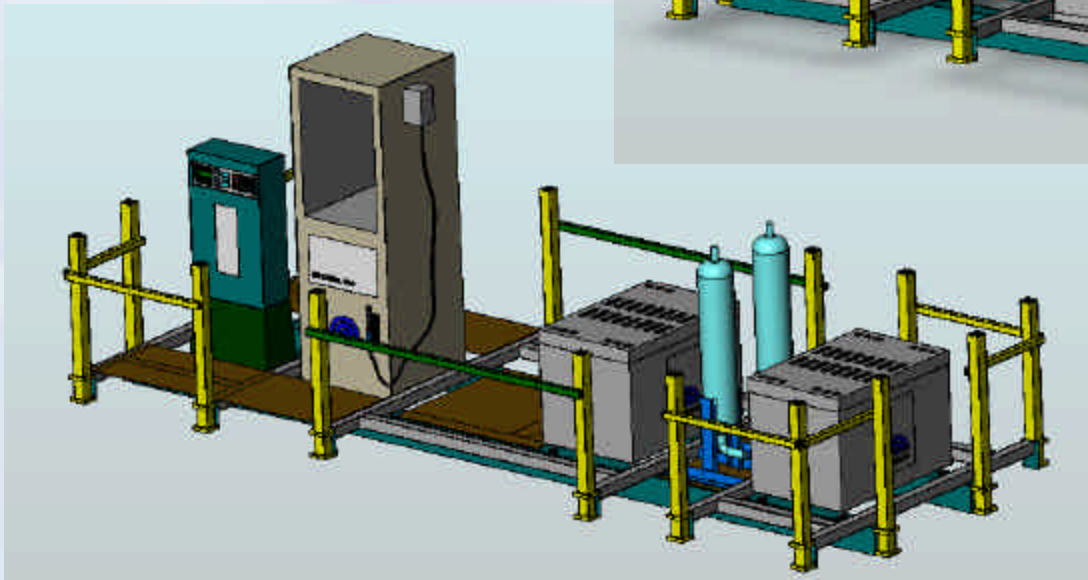
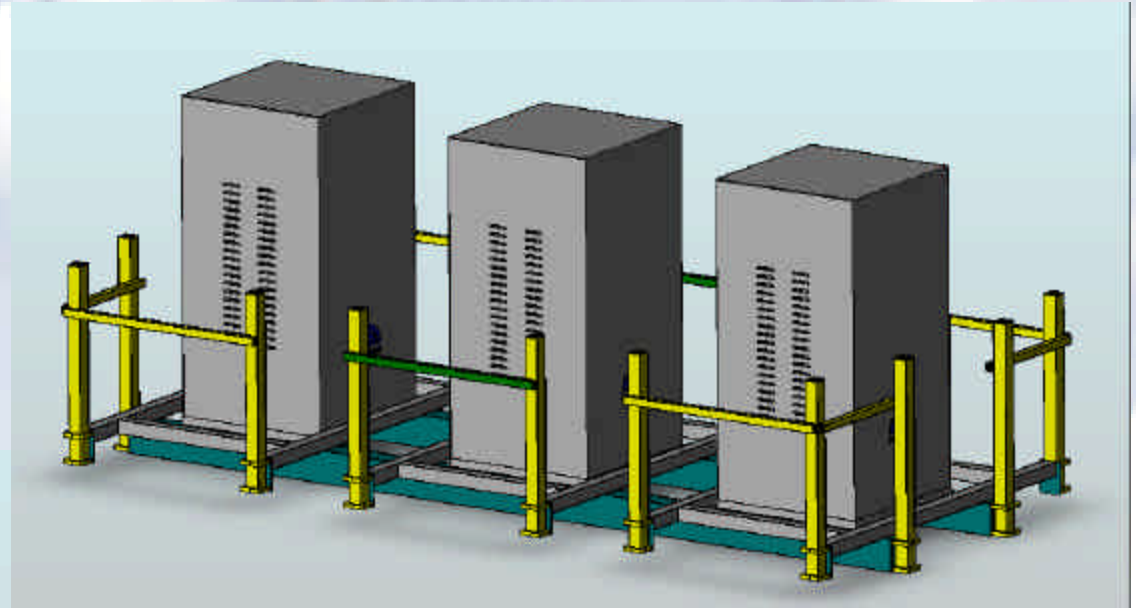




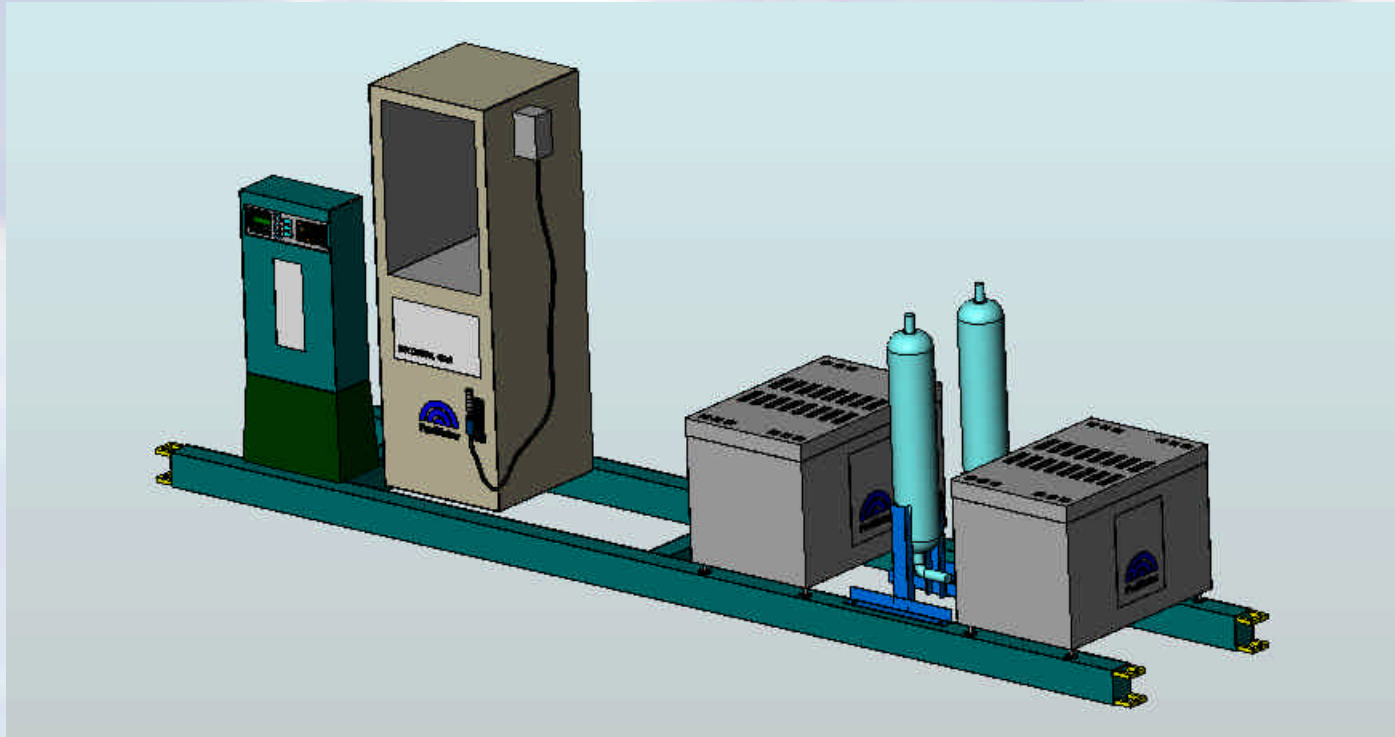
- 2 hollow structural steel “skids”
- ship to site with all equipment installed
- vehicle impact protection attached on site
- external connections made at bulkhead points

# Mini Fast Fill

## Skid Mounted Version

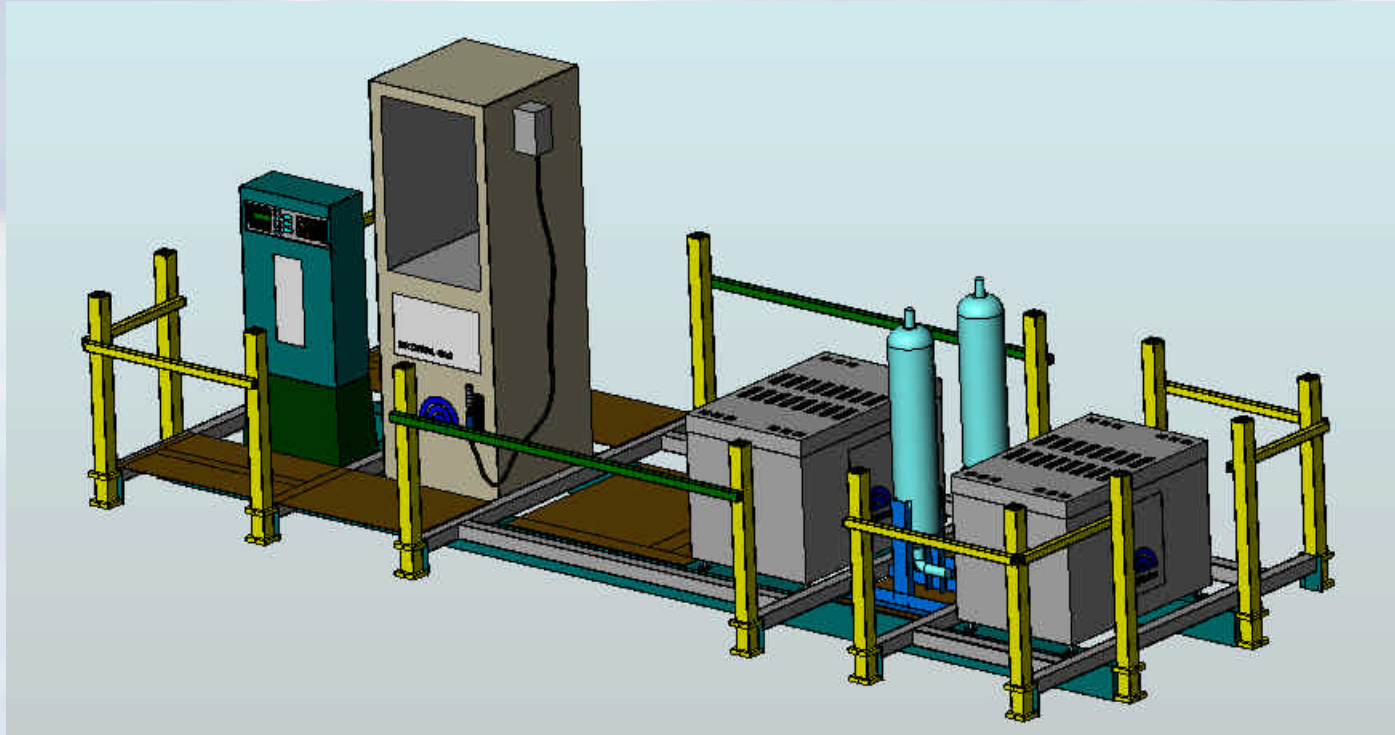


# Mini Fast Fill, Dispenser & VRAs Skid Mounted Version



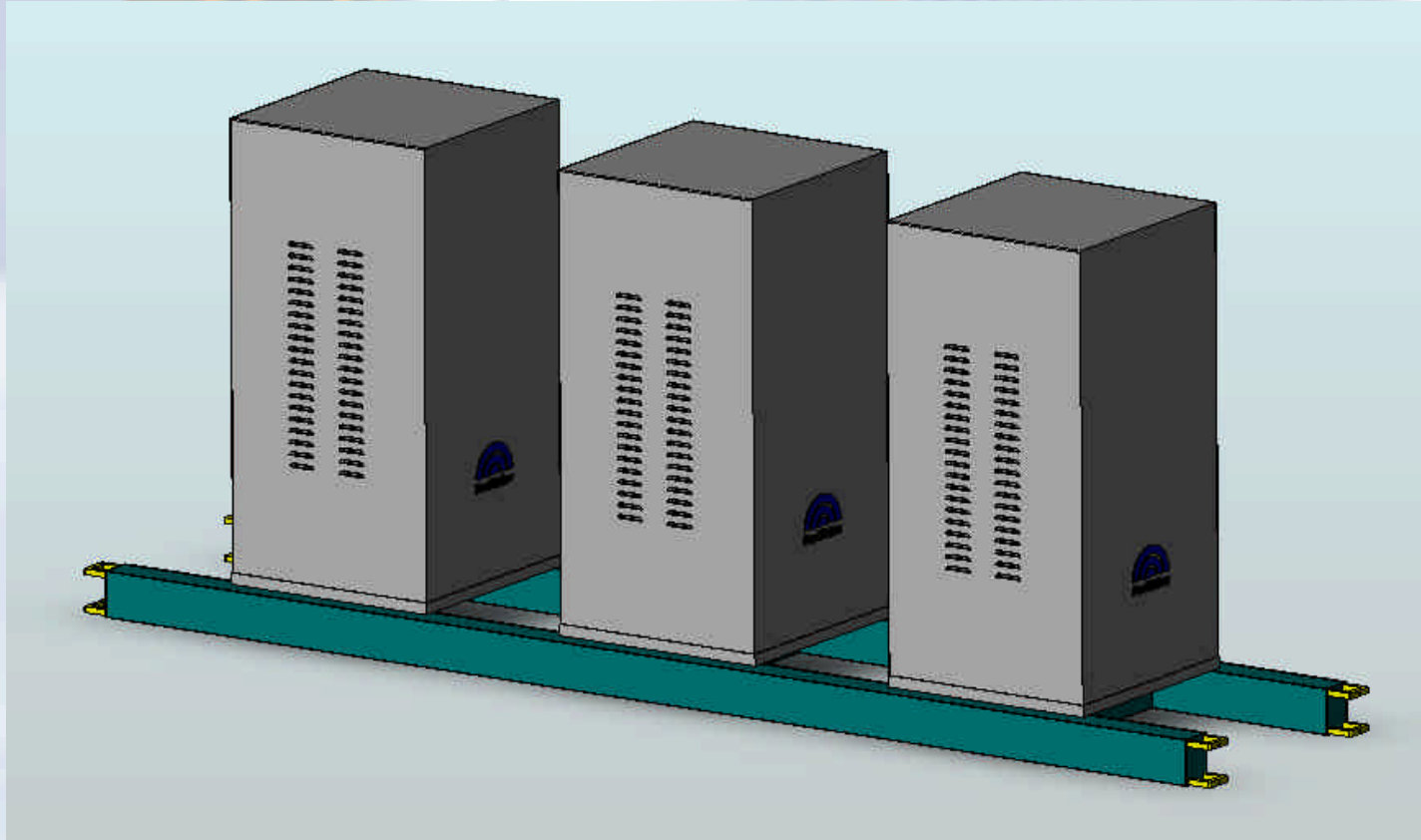
**As Shipped to Site**

# Mini Fast Fill , Dispenser & VRAs Skid Mounted Version



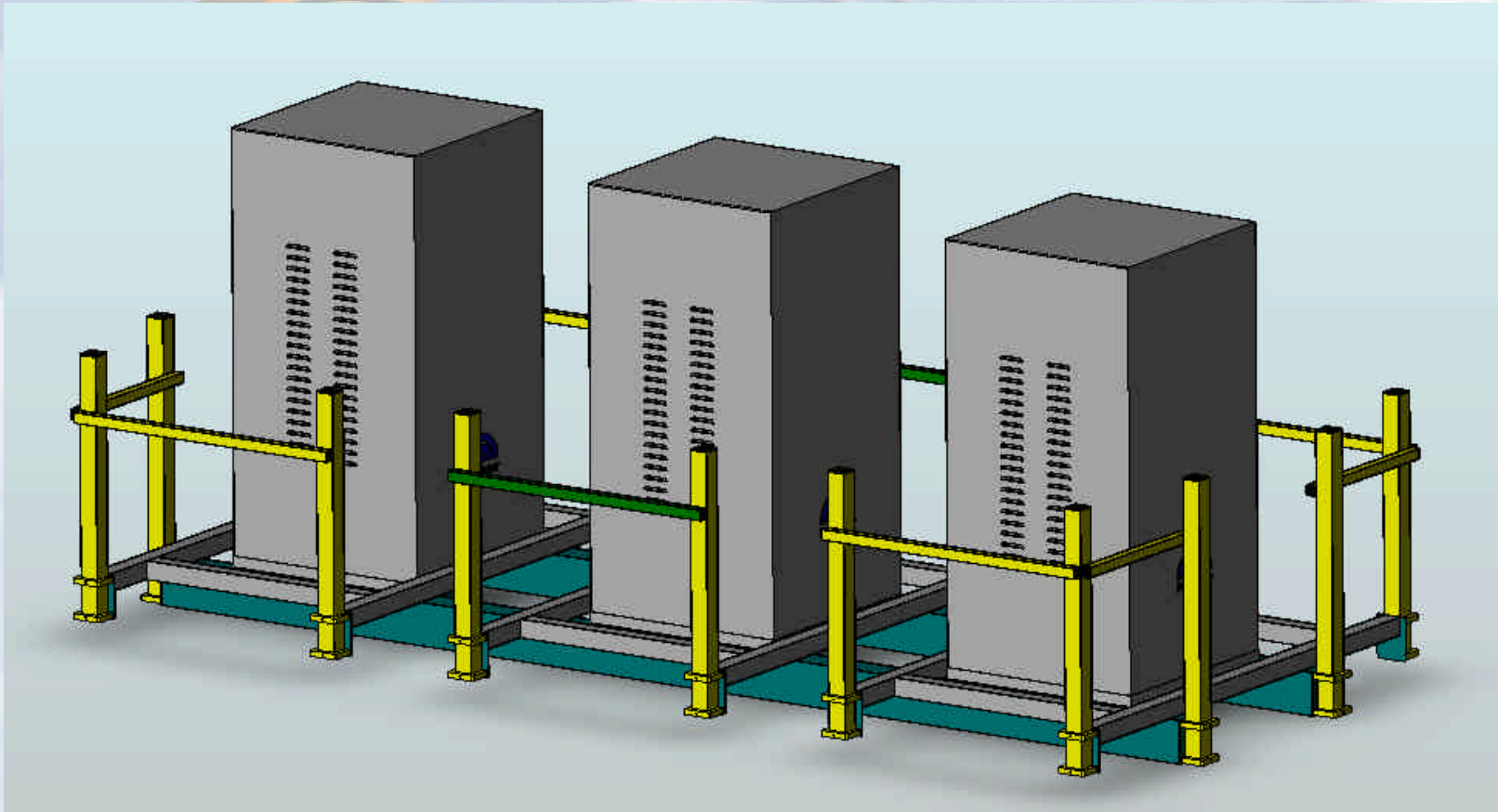
**On-Site with Impact Protection Installed**

# Mini Fast Fill, Storage Skid Mounted Version



**As Shipped to Site**

# Mini Fast Fill, Storage Skid Mounted Version



**On-Site with Impact Protection Installed**



## Pricing

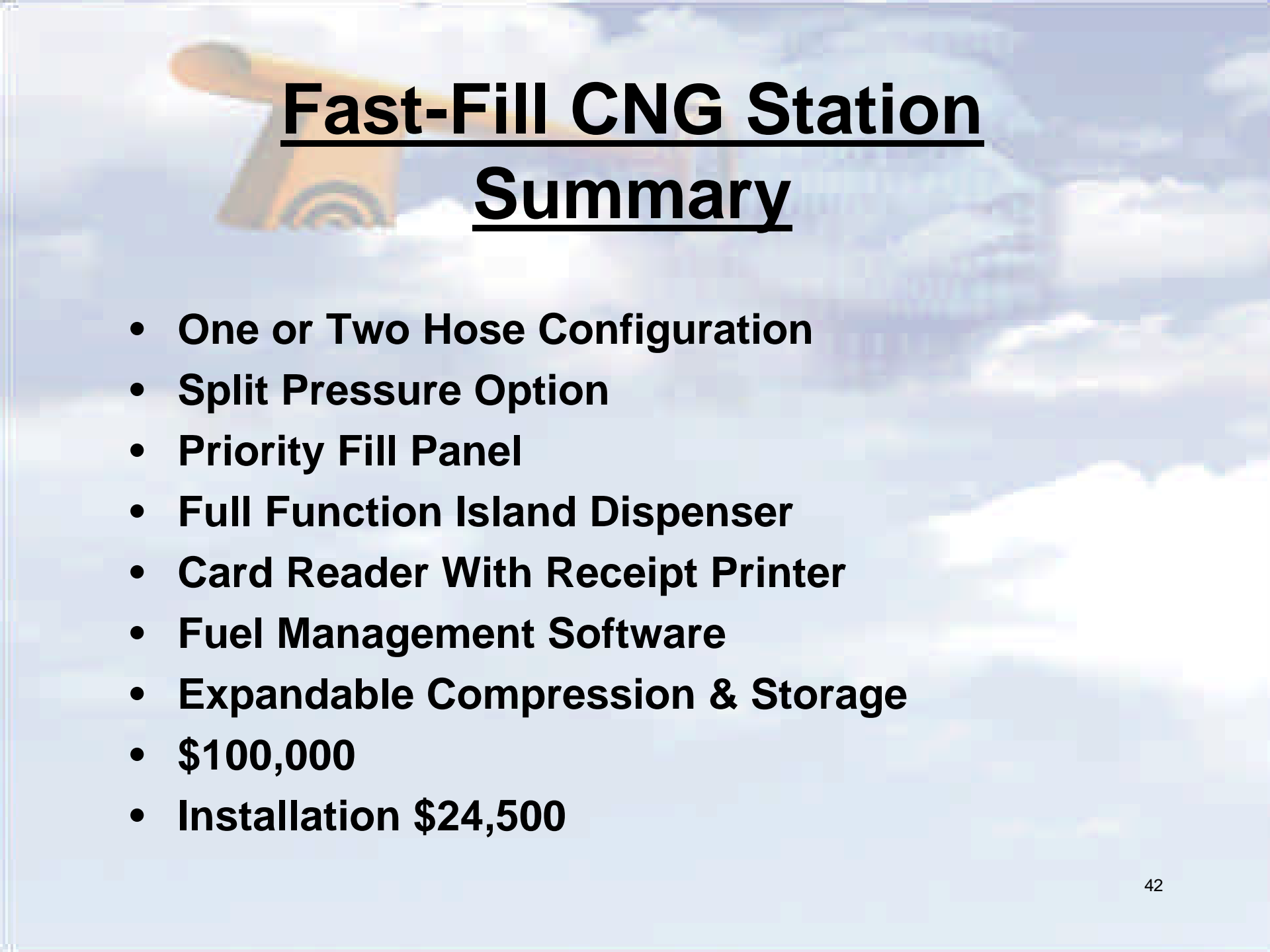
### 50.328 Fast-Fill CNG Station (P36)

#### **Complete with:**

- **Two 4,200 psig VRAs**
- **Two Low Pressure Gas dryers**
- **Two Three Bank Storage Systems Comprised of:**
  - **One Three Bank Storage System and;**
  - **One Three Bank Supplemental Storage System**
- **Priority Fill Panel**
- **3,600 psig Single Hose Temperature Compensating, Auto Sequencing Island Dispenser**
- **Card Reader**

.....**\$ 101,115**





# **Fast-Fill CNG Station**

## **Summary**

- **One or Two Hose Configuration**
- **Split Pressure Option**
- **Priority Fill Panel**
- **Full Function Island Dispenser**
- **Card Reader With Receipt Printer**
- **Fuel Management Software**
- **Expandable Compression & Storage**
- **\$100,000**
- **Installation \$24,500**